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Short communication

P 097—Metabolic cost of transport in over-ground and treadmill walking of healthy elderly and effects of a treadmill familiarization protocol

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ABSTRACT

Background: Previous research has shown that the mechanics of walking on a treadmill is similar to walking overground. However it might be true that the energetics of walking is not similar between overground and treadmill, especially for older adults.

We hypothesized that a lack of or inadequate familiarization on a treadmill would increase the Metabolic Cost of Transport (MCoT) in older adults due to increased levels of anxiety and the novelty of the locomotor task.

Methods: 10 healthy elderly (5 males and 5 females, mean age of 75.3 SD(6.3) years) were recruited and they walked first at their overground Preferred Walking Speed (PWS) for 8 min to reach a steady state of oxygen consumption in the morning. After that the same speed was imposed on a dual-belt treadmill and they walked for 15 min to properly familiarize themselves with the treadmill. This was called the familiarization session (Session 1). In the afternoon they repeated both the overground and treadmill walking again in the same order and with the same protocol. This session was called the post-familiarization session (Session 2).

Results: The group average of the overground PWS was 1.28 SD(0.11) m/s (4.61 SD(0.40) km/hr). During the familiarization session, the group average of the Gross Cost of Transport (GCoT) was 3.47 SD(0.35) J/kg/m while walking overground and 4 SD(0.65) J/kg/m while walking on a treadmill. The Net Cost of Transport (NCoT) was 2.64 SD(0.37) J/kg/m while walking overground and 3.14 SD(0.64) J/kg/m while walking on a treadmill. During the post-familiarization session, the group average of the GCoT was 3.84 SD(0.35) J/kg/m while walking overground and 3.94 SD(0.67) J/kg/m while walking on a treadmill. The NCoT was 2.76 SD (0.39) J/kg/m while walking overground and 2.90 SD(0.68) J/kg/m while walking on a treadmill.

Both the GCoT and NCoT were statistically significantly higher on a treadmill than overground during the familiarization session. This elevation was not present during the post-familiarization session. There were also no statistically significant differences in the Resting Metabolic Rate (RMR) between before walking overground and before walking on a treadmill in either the familiarization or the post-familiarization session.

Discussion and Conclusion: This shows that the energetics of walking can be different for even healthy elderly on a treadmill if they are not or inadequately familiarized to it. This underlines the importance of adequate familiarization to treadmill walking for elderly in trying to understand the MCoT in this population.

1. Introduction

It has been previously established that Treadmill (TM) walking is mechanically similar to Over-ground (OG) walking [1]. However there has been no consensus among researchers whether the metabolic requirements are similar for both the modes [2–7].

2. Research question

We want to investigate why is the Metabolic Cost of Transport (MCoT) predominantly higher on a treadmill for healthy elderly than overground. We hypothesize that the elevation is due to improper familiarization and task novelty of treadmill walking, leading to increased anxiety.

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Fig. 1. Experimental setup of an elderly subject walking Over-ground (OG) (Left) and walking on a Treadmill (TM) (Right).

3. Methods

We recruited 10 healthy elderly (5 males and 5 females, mean age of 75.3 SD (6.3) years), free from any other morbidities, apart from age. The participants walked at their Preferred Walking Speed (PWS) over-ground and then the PWS was imposed while walking on an instrumented dual-belt treadmill (Fig. 1). There were two sessions for the protocol:- 1. Familiarization session (over-ground and at least 15 min of walking on the treadmill at their imposed over-ground PWS) (Session 1) and 2. A post-familiarization session (both over-ground and treadmill) (Session 2). Oxygen consumption was analyzed during both over-ground and treadmill walking, after the subjects reached a steady state of metabolic energy consumption. Resting Metabolic Rate (RMR) measurements were done while sitting, before each and every walking protocol.

4. Results

There was a statistically significant elevation in both the Gross and Net Costs of Transport (GCoT and NCoT) of the treadmill mode in the familiarization session. Interestingly the elevation was insignificant in the post-familiarization session (Fig. 2). Mean PWS – 1.28 SD (0.11) m/s (4.61 SD (0.40) km/hr) (Table 1).

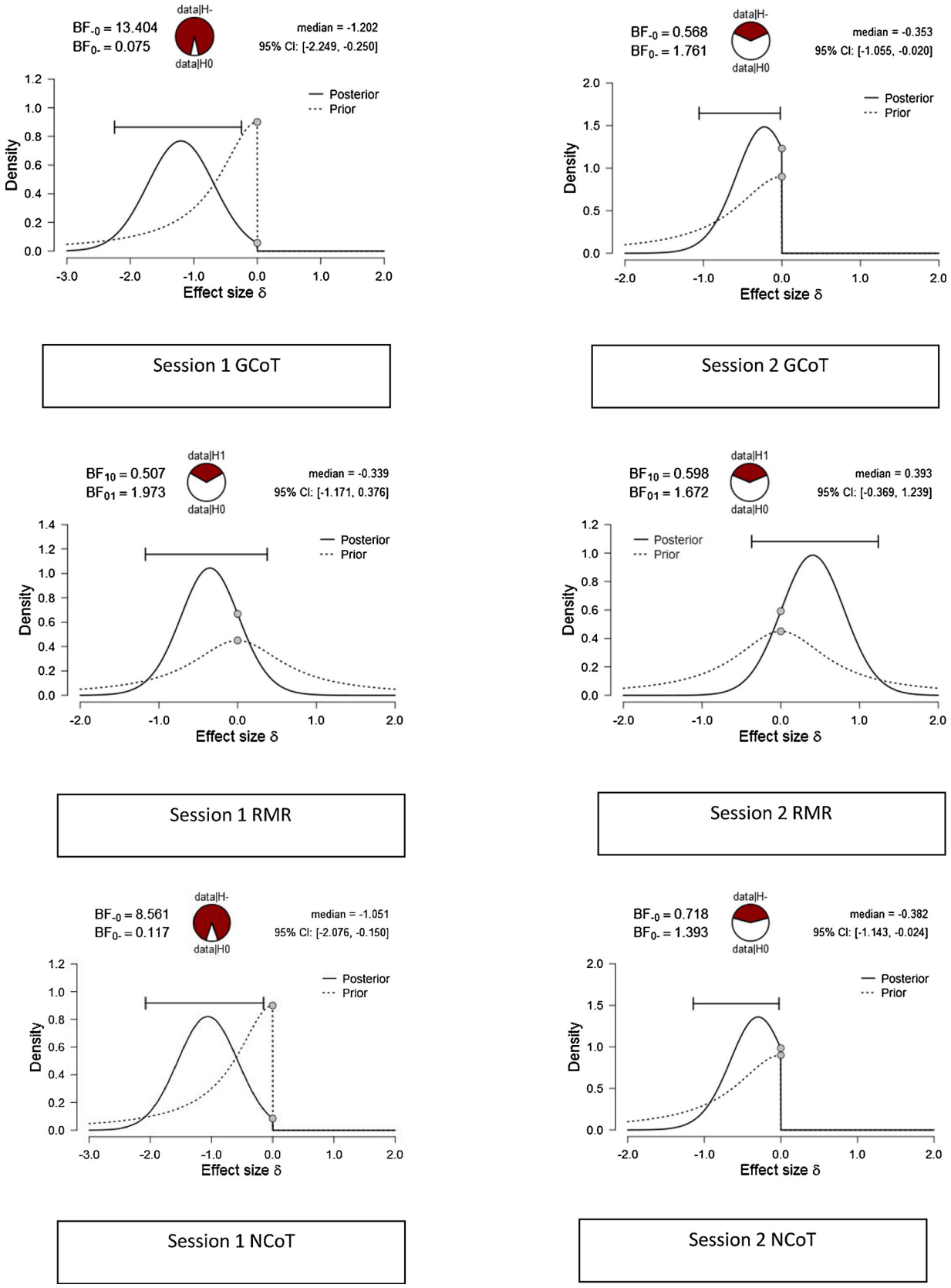

Fig. 2. Bayes factors, 95% Credible Intervals, Prior and Posterior distributions for the alternative hypothesis that both the GCoT and NCoT are lower for OG walking than TM walking for healthy elderly. The alternative hypothesis for the RMR is that the RMR is different between before walking OG and before walking on a TM. The data for both the sessions are shown for GCoT, RMR and NCoT.

Table 1
Overview of the measured values and percentage differences in GCoT, RMR and NCoT between TM and OG during both the familiarization and post-familiarization sessions.

	Mean GCoT (J/kg/m)	Percentage increase in TM over OG	Mean RMR (J/kg/min)	Percentage difference between TM and OG	Mean NCoT (J/kg/m)	Percentage increase in TM over OG
OG (Session 1)	**3.47 SD(0.35)**		63.25 SD(13.47)		**2.64 SD(0.37)**	
TM (Session 1)	**4.00[*] SD(0.65)**	**15.3**	66.29[$] SD(7.78)	4.8	**3.14[*] SD(0.64)**	**18.9**
OG (Session 2)	3.84 SD(0.35)		82.98 SD(13.84)		2.76 SD(0.39)	
TM (Session 2)	3.94[$] SD(0.67)	2.6	79.78[$] SD(16.20)	−3.9	2.90[$] SD(0.68)	5.1

The difference between the GCoT and NCoT values of OG and TM walking for only these bold values is statistically significant in Session 1.
[*] Statistically Significant Elevation.
[$] Equivalent for Cohen's d (−1 to 1) and (−1.41 to 1.41).

5. Discussion

This shows that a proper treadmill familiarization is extremely important and should always be done to eliminate the effect of the raised costs of transport in elderly due to the treadmill itself.

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